NASA SP-5967 (02)

TECHNOLOGY UTILIZATION

COMPUTER PROGRAMS: SPECIAL APPLICATIONS

A COMPILATION

9A 40

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Foreword

The National Aeronautics and Space Administration has established a Technology Utilization Program for the dissemination of information on technological developments which has potential utility outside the aerospace community. By encouraging multiple application of the results of its research and development, NASA earns for the public an increased return on the investment in aerospace research and development programs.

This publication is part of a series intended to provide such technical information. The items herein reported range widely in the field of computer programs, and they may interest scientists, engineers, and/or business administrators.

Additional technical information on individual devices and techniques can be requested by circling the appropriate number on the Reader Service Card included in this Compilation.

Unless otherwise stated, NASA contemplates no patent action on the technology described.

We appreciate comment by readers and welcome hearing about the relevance and utility of the information in this Compilation.

Jeffrey T. Hamilton, *Director*
Technology Utilization Office
National Aeronautics and Space Administration

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Contents

Section 1. Measurements and Testing Programs

TWO-GAS CABIN LEAKAGE PROGRAM

The leakage rate from a two-gas spacecraft cabin having oxygen resupply is simulated by this program. The purpose is to determine oxygen partial pressure as a function of time in a two-gas atmosphere, with oxygen resupplying leakage at a rate to maintain constant cabin pressure and, thus, effectively purging the cabin with oxygen.

Input consists of gas parameters for oxygen and diluent gas, effective leakage flow area, constant cabin temperature, constant total pressure, volume, and initial oxygen partial pressure.

Output is time, partial pressure of oxygen, partial pressure of diluent gas, mass flow rate of mixture out, and mass flow rate of oxygen into the cabin.

Language: FORTRAN V
Machine Requirements: UNIVAC 1108

Source: L. W. Morgan of
Lockheed Electronics Co.
under contract to
Johnson Space Center
(MSC-13221)

Circle 1 on Reader Service Card.

PROGRAM TO COMPARE AND QUALIFY FORMAT TELEMETRY DATA TAPES

This is an assembly language program which has several options to be selected to perform varying types of data qualification.

It scans an input tape to insure that time is incremented properly, records the maximum and minimum values for each measurement on the tape, and flags any which exceed the transducer range.

The program compares all measurements which appear on format input tapes with like or unlike sample rates and outputs all of the tolerance values. It compares each data point for all measurements from one input tape against its transducer range and outputs all values which are out of tolerance. Each data point can also be compared with the results of a previous scan.

Although it is designed for use with NASA format telemetry data tapes and is used as a qualification tool for S-2 telemetry data from static firing and flight, the program should find use with other data tapes.

Language: IFNAP
Machine Requirements: CDC 924A

Source: Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-16761)

Circle 2 on Reader Service Card.

SOFTWARE CONTROL FOR LARGE-SCALE ONBOARD CHECKOUT: A CONCEPT

Often it is desirable to monitor over 4000 test points of sensory data coming from several subsystems. A data-management system must provide a self-checking capability for the monitoring system and be able to recover from unexpected error or failure interruptions. In addition, it must perform operational duties of navigation, control, and experimentation.

A two-level system checkout satisfies the continuous monitoring requirements and the second level provides fault isolation to satisfy the maintenance requirements.

The program contains the test, control, monitor, and operational features required for the system and includes an interrupt feature to permit rapid servicing for malfunctions or errors. Automatic polling and limit checking of system test points are performed at the signal sources for equipment-failure detection. The word format is such that flag bits, in designated bit positions within each word, will indicate that specific remote data acquisition channels are out of tolerance. A copy of the bit-register output is maintained within data bus terminals which provide the interface to the data bus. Data bus controllers, performing as input/output channels, poll the terminal registers for out-of-tolerance flag bits.

Specific operational duties and maintenance tests are flowed and sized. These tests include processor tests, memory tests, channel/terminal/signal source-wrap tests, and display tests. To support these tests, block formats and tables are itemized, including: a device-address table, a limit-check table, a data-path table, a rate table, a repair-time table, a processor table, a directory table, and a memory-allocation table.

To support program interruption and restart, a data-logging system for checkpointing and restart is evolved, and supervisory flows for the data logging are developed. Executive services of both a master and an onboard checkout controller are itemized for the support of onboard checkout functions.

This innovation is in the conceptual stage only. At the time of this publication, no model or prototype exists.

Source: H. K. Grounds and D. H. Norton, Jr., of IBM Federal Systems Division under contract to Johnson Space Center (MSC-13977)

Circle 3 on Reader Service Card.

SNAP DYNAMICS

A fast and economically efficient method was needed to calculate the normal vibration modes of complex structures. Available methods required excessively large amounts of input data, run time, or core storage.

A program was developed specifically to eliminate these problems.

Computer-run time is minimized by reducing to a minimum the number of operations within the machine and the amount of data transferred to and from secondary storage.

Both run times and storage requirements are decreased by considering only the nonzero elements of the matrices and by taking advantage of all symmetry conditions. Pseudoinverse and iteration are used to find only needed modes.

The data input is a group of data libraries, and the structure is visualized as a structural network. A series of accuracy checks are made with each iteration and are printed out for the user. Provision for accuracy improvement is also included.

Language: FORTRAN V
Machine Requirements: UNIVAC 1108

Source: L. Kiefling, W. D. Whetstone, and C. E. Jones Marshall Space Flight Center (MFS-21531)

Circle 4 on Reader Service Card.

PREDICTION OF DUCTED-FAN PERFORMANCE

There was a need to determine the performance of a ducted fan in terms of axial flow and angle of attack, by making improvements and additions to an existing program.

A new program was developed to determine the performance of a ducted fan in axial flow and at a specified angle of attack. Improvements to the existing program consist of adding a capability for angle-of-attack flow, computing duct surface-pressure distributions, adding a center-body model, and removing certain restrictions on advance-ratio and nonlinear blade-lift characteristics.

The program is used to predict the performance at a specified advance ratio and angle of attack of a given fan-duct combination, which is specified by: (a) the radial distributions of blade pitch, chord, and thickness; (b) the duct chord, diameter, camber, and thickness distribution; (c) the fan location; and (d) the center-body geometry.

The information obtained from the program includes: duct-and-fan thrust, ducted-fan normal force, pitching-moment coefficient, radial distributions of fan-inflow velocity, and blade angle of attack. The duct surface-pressure distribution at any specified azimuthal angle is also calculated.

The computation proceeds as follows: An initial knowledge of the fan-inflow-velocity profile is required in order to compute blade performance, from which all other computations are made. Since the inflow is affected by the as-yet-undetermined duct-bound vorticity, an iterative procedure is used. An initial uniform inflow of 2 V is assumed, and the blade-element calculations are made to determine the fan performance and wake characteristics. The flow-tangency condition on the duct-reference cylinder is then applied to determine the duct-bound vorticity distribution. With all of the singularity distributions known, the fan inflow is calculated and compared with the initially assumed inflow. If the two do not agree, a new inflow equal to the average between the initial and the computer inflows is determined. The fan and duct-bound vorticity calculations are repeated to obtain a new inflow. The process continues until the inflow velocity in each annulus has converged to within the desired value. When convergence is obtained for all annuli, the program continues to calculate the force and moment coefficients and the duct surface-pressure coefficients, if desired.

Language: FORTRAN IV
Machine Requirements: IBM 7094

Source: Michael R. Mendenhall
and Selden B. Spangler of
Nielsen Engineering & Research Inc.
under contract to
Ames Research Center
(ARC-10615)

Circle 5 on Reader Service Card.

RAY PATHS IN THE SOLAR CORONA (SUNBEND 2 PROGRAM)

The analysis of Faraday rotation in the solar corona requires a knowledge of the ray path through the solar corona. Sophisticated techniques usually required for the ionosphere are not necessary at solar distances on the order of 2 to 10 solar radii from the limb of the sun. This program assumes a solar corona model with radial symmetry composed of uniform stratified layers and computes the ray bending of a CW signal as it passes through the plasma of the solar corona.

Language: FORTRAN V (96%), DATA (4%)
Machine Requirements: UNIVAC 1108

Source: Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11233)

Circle 6 on Reader Service Card.

SYSTEMS EFFECTIVENESS EVALUATION PROGRAM

It was desired to reduce the man-hours needed to perform routine monitoring and assessment of the effectiveness, reliability, and maintainability of large electronic equipment systems.

A system of eight integrated computer programs provides the needed capability. The programs were originally developed to assess the reliability and maintainability of twelve sets of Acceptance Checkout Equipment/Spacecraft (AEC-S/C), each set containing 175 racks of equipment and 1,000,000 piece parts. These programs reduced requirements from five full-time personnel to one part-time person and provided a more comprehensive monthly assessment, with automatic update of previous assessments.

The inputs to the System-Effectiveness Evaluation (SEE) program consist of system configuration data, elapsed-time meter readings, and edited failure reports.

The SEE program outputs are:

a. Mean Times Between Failures (MTBF) and Mean Times To Repair (MTTR) for all unique parts or assemblies, for all subsystems, and for the system itself, with associated confidence parameters and weak-link flags;
b. Printer-plotter trend charts of the MTBF's and the MTTR's;
c. MTBF and MTTR correlation charts comparing the performances of all ground stations;
d. Computations of system reliability, availability, and expected cumulative downtime during a simulated mission; and
e. Numerous utility programs used in spares predication and in the identification of problem areas.

An essential requirement is the proper and timely integration of data from four separate and distinct processes:

1. The precise encoding of the complete logical description of all equipment;
2. The encoding being performed with translation tables;
3. The systematic reporting and processing of failure experiences; and
4. The periodic recording and processing of equipment operating times.

The primary feature of the SEE program is the ability to pinpoint rapidly equipment problem areas for corrective action, down to the lowest possible level of assembly. The programs can be modified for any large complex electronic system.

Language: FORTRAN IV (68%), GMAP (32%)
Machine Requirements: GE 635

Source: H. P. Nicely, Jr., and W. D. Givens of General Electric Co. under contract to NASA Headquarters (HQN-10306)

Circle 7 on Reader Service Card.

COMPUTER PROGRAM FOR CALCULATING THE TEMPERATURE FIELD OF FACE SEALS

A computer program has been developed for calculating the temperature field of shaft seals. Shaft seals are composed of basically axisymmetric bodies. The circumferential temperature gradient approaches zero for most applications; thus, the cylindrical coordinate system is used as a basis for analysis.

Face seals in advanced gas-turbine engines will be subjected to temperatures, pressures, and sliding surface speeds higher than those in current engines. Increases in temperature arise from continuing increases in flight speed and turbine-inlet temperature. In order to cope with these higher temperatures, the contacting-type face seal may be replaced with noncontacting face seals. However, regardless of the type of face seal used, deformation of the sealing faces due to thermal gradients will have significant effects on seal performance. Deformations due to thermal gradients are a major problem area.

The first step in determining thermal deformation is calculation of temperature distribution in the seal assembly. The following restrictions are placed on the thermal analysis: (1) a steady state must exist; and (2) an axisymmetric temperature field must exist.

Various convection and radiation-boundary conditions which can be used are given in the developed mathematical formulations. The program is designed to permit ready substitution of other boundary conditions or other expressions for the heat-transfer coefficients. Furthermore, additional boundary conditions can be added readily. Also given are program listings and flow charts for the steady-state thermal solution of an axisymmetric solid in cylindrical coordinates.

The program is quite general and can be applied to a variety of axisymmetric body problems. The calculation procedure requires that these bodies be divided into an arbitrary finite number of axisymmetric volume elements or nodes. There is no requirement that the nodes be equal in cross section. The program takes into account contact resistance at the interface between nodes and also accounts for material properties that vary from node to node. Provisions are made in the program to handle varying gas temperatures along the seal boundaries and internal viscous-heat generation within the fluid at the boundaries.

Language: FORTRAN IV
Machine Requirements: IBM 7094

Source: Terrence E. Russell, Gordon P. Allen, Lawrence P. Ludwig, and Robert L. Johnson
Lewis Research Center
(LEW-11110)

Circle 8 on Reader Service Card.

ANALYSIS AND COMPUTER PROGRAM TO CALCULATE ACOUSTIC WAVE PROPERTIES OF BAFFLED CHAMBERS

Analytical methods and four computer programs have been developed for calculating the wave motion in closed baffled chambers with rigid and nonrigid boundaries. Application of these methods to the design of injector-face baffles in liquid-propellant engines will provide significant insight into the effects of baffles on combustion stability.

Approximate solutions to the wave equation, with essentially continuous pressure distributions, were obtained for closed two-dimensional chambers containing an unrestricted number of equal-length and equally spaced baffles. Solutions were obtained by converting the wave equation and boundary conditions to an integral equation; this integral equation was solved with a combination of variation and iteration methods. The mathematical techniques used to obtain these solutions apply equally well to cylindrical or annular chambers and to unequal baffle lengths or spacing, although with some increase in complexity.

These methods encompass solving the wave equation for the baffled chamber by converting the differential equation and boundary conditions to an integral equation, which, in turn, is solved by approximate means. A variational technique, in combination with an iterated approximation, was used to solve the integral equation. Numerical results were obtained for two-dimensional chambers containing one or several equal-length and equally spaced baffles. The results show an essentially continuous pressure distribution along the baffle tips. Requirements for continuity of velocity and energy flux are met automatically with this method. Furthermore, the effects of a single baffle on the stability of a chamber with nonrigid walls, i.e., gain/loss type boundary conditions, have been successfully analyzed for one particular two-dimensional geometry. Thus, the ability to generalize the method for nonzero boundary conditions has also been demonstrated.

The first computer program was written to solve the iterative characteristic equation for the rigid boundary case. The method used to solve this equation was to calculate the value of the function, while incrementally changing the wave characteristic and frequency until the value of the function changed signs. The usual practice was to calculate the characteristic equation over a large interval, by taking large increments for the wave characteristic. After noting the interval in which the value of the function changed signs, that interval was subdivided into small increments. The procedure was repeated until an accurate value of the wave characteristic was obtained.

The second program calculates the pressure across the baffle tips, on the main chamber side of the interface across the baffle tips. With the wave characteristic fixed for a given set of parameters, it is possible to determine the relationship between pressure and the position coordinate. Pressure at the baffle tips was calculated across the width of the chamber.

The third program was used to calculate the pressure at the baffle tips, on the compartment side of the interface. Considering the pressure as a function of the position coordinate, it is possible to determine the pressure for a given wave characteristic.

The fourth program was written to determine the stability limit of a combustion chamber with active boundaries located at both ends. The characteristic equation is in complex notation, and the root of the characteristic equation is a complex eigenvalue (the real part is the nondimensional frequency, and the imaginary part is the nondimensional damping coefficient). Thus, for a given set of parameters, nozzle admittance, and injector admittance, the complex root, which satisfies the characteristic equation, specifies the frequency and the damping coefficient of the system. The acoustic admittance obtained defines the maximum amount of acoustic energy (related to the admittance) that can be pumped into the system and still have the system stable. This avenue was taken to evaluate the stability limit.

Language: FORTRAN IV
Machine Requirements: GE 420

Source: C. L. Oberg, T. L. Wong, and R. A. Schmeltzer of Rockwell International Corp. under contract to Lewis Research Center (LEW-11529)

Circle 9 on Reader Service Card.

COMPUTER PROGRAM TO GENERATE ATTITUDE ERROR EQUATIONS FOR A GIMBALED PLATFORM

Frequently, there is need for a method by which attitude-error equations, suitable for use in a flight program, can be generated for a platform with a given gimbal order. The generation of the equations requires the expansion and reduction of seven third-order matrices for a four-gimbal platform. Once expanded, the equations can be reduced using fundamental trigonometric identities for the sum of two angles. The expansion and subsequent reduction of these equations is time consuming, tedious, and virtually impossible to perform without error.

A computer program was developed which will generate the matrix elements of the attitude-error equations, when the initial matrices and trigonometric identities have been defined and provided as program input.

Through the use of an extension of the OS/360 PL-1 (F) compiler (known as the PL-1-FORMAC interpreter), the matrices, whose elements are the sines and cosines of the guidance commands and related gimbal angles, can be multiplied to form the matrix product; and like terms can be collected for each element of the product.

Input to the program consists of up to seven input matrices entered in PL-1 data-directed format on cards. Output is a printout of individual matrix elements for each matrix product. A final matrix product, after reduction of terms using trigonometric identities, is also printed.

The process used to generate equations in this program can be employed whenever matrix manipulation is required. Use of this program enables one to obtain equations in a linear form rather than in a matrix form. This is useful, as well as cost effective, when a program is implemented which will be run many times, as in the case of simulations.

This program is written in PL/I-FORMAC to be utilized on the IBM-360/75 computer. 260K bytes of storage, a 9-track tape drive, and a 2311 disk drive are required to run the present version.

Language: PL-1-FORMAC
Machine Requirements: IBM 360/75 COM

Source: W. A. Hall, Jr.,
T. D. Morris, and
K. Y. Rone of
IBM Corp.
under contract to
Marshall Space Flight Center
(MFS-21991)

Circle 10 on Reader Service Card.

VIBRATIONAL TRANSFER FUNCTIONS FOR COMPLEX STRUCTURES

The accuracy of structurally mounted instrumentation and experiments with precise pointing requirements is greatly dependent on operational vibration levels. This vibration environment is due to structural response to various forcing functions applied during operation-of-equipment experiments.

By developing vibrational transfer functions between equipment support areas and points of applications of forcing functions, the effects of vibrational multiple-frequency forcing functions may be evaluated. A general computer program has been developed for this purpose.

The generated transfer functions can be used to determine structural response due to a variety of forcing functions. These are: (1) single-frequency, (2) multiple-frequency, (3) random, and (4) complex-periodic. The program has the capability of analyzing any complex structure composed of up to 50 substructures, with a maximum of 162 degrees of freedom in each substructure. There is also capability of providing plots of the transfer functions, which can easily be used to determine vibrational response to any given forcing function in the above categories.

The basic input to the program is the coupled-structure modal properties. It should be noted that, for use of the response-transfer-function program, basic structural analysis programs, such as finite-element and modal-analysis programs, must be available.

Possible applications of this program are the determination of:

1. The instrumentation and experiment motion due to equipment-generated forcing functions for aerospace structures such as payloads in orbit;
2. The response of a land vehicle to operational forcing functions such as rough roads, represented by steady-state or random inputs; and
3. The structural response of equipment-support structure to excitation generated by stationary machinery.

Language: FORTRAN IV
Machine Requirements: CDC 6500/CDC 280 Plotter

Source: P.A. Jones and
R.L. Berry of
Martin Marietta Corp.
under contract to
Marshall Space Flight Center
(MFS-20744)

Circle 11 on Reader Service Card.

Section 2. Navigation and Tracking Programs

ASPECT ANGLES AND STANDARD THEORETICAL TRAJECTORY TAPE-CONVERSION PACKAGE

This program package consists of two programs. The first, Aspect Angles Program, defines two methods for computing aspect angles from a given station to a vehicle on a point-by-point basis. The aspect angles are defined as: (1) the angle θ between the positive roll axis of the vehicle and the sighting vector and (2) the angle ϕ between the positive yaw axis and the projection of the sighting vector onto the roll plane.

The first method employs the direction cosines of the vehicle axes (roll, pitch, and yaw), with respect to an earth-centered EFG system. The second method employs vehicle velocity components, with respect to a pad-centered XYZ system, in conjunction with the angle of attack (α) and assumes that the pitch axis is always parallel to the cross-range (Z) axis.

The EFG system is earth-fixed, and the E-F plane coincides with the equatorial plane. The E axis cuts the meridian of the pad with the F axis, 90 degrees east of the E axis. The G axis coincides with the earth's rotational axis, positive north. The XYZ system has the X-Z plane tangent to the surface of the spheroid at the pad, with the X axis directed at some azimuth (XAZ) from north, the Z axis directed at XAZ + 90 degrees and the Y axis normal to the X-Z plane, positive up.

There are three options to this program. The first option computes the aspect angles, using the direction cosines and taking vehicle data from a standard KSC trajectory tape in the form of latitude (ϕ), longitude (λ), and altitude (h). The second option uses XYZ position and velocity from the KSC tape by the velocity vectors method but assumes that α data are always zero. The third option is the same as the second except that α data are read in from cards.

As output, the program has one binary tape, giving the time and aspect angles. In addition, there is a tabular printout of the output data.

The first program has one standard trajectory tape input which is produced by the second program in the package, Standard Theoretical Trajectory Tape-Conversion Program. This program processes and prints data obtained from a Standard Theoretical Trajectory Tape.

Language: FORTRAN IV (45%), GMAP (55%)
Machine Requirements: GE 635

Source: Kennedy Space Center (KSC-10412)

Circle 12 on Reader Service Card.

PROGRAM FOR COORDINATE CONVERSION OF LATITUDE, LONGITUDE, HEIGHT TO XYZ AND OF XYZ TO LATITUDE, LONGITUDE, HEIGHT

This program package consists of two programs. The first is titled Coordinate Conversion of Latitude, Longitude, Height to XYZ; the second is titled Coordinate Conversion of XYZ to Latitude, Longitude, Height.

The first program provides the capability of converting geographic coordinates to rectangular coordinates. The inputs are the semimajor and semiminor axes of the spheroid; the azimuth of the X axis; the reference time; the latitude, longitude, and height of the system origin; and the point. The output consists of the inputs and the transformed rectangular coordinates X, Y, Z.

The second program converts XYZ pad-centered coordinates to latitude, longitude, and height. The inputs are the semimajor and semiminor axes; the azimuth of the X axis with respect to true north; the start and stop times; the latitude, longitude and height of the XYZ system origin; the XYZ coordinates of the point; and the reference time. The output consists of the inputs as described above and the transformed coordinates, latitude, longitude, and height.

For both programs, the input coordinates may be on cards or tape, and the output coordinates may be either tabulated listings or tape.

Language: FORTRAN IV (92%), GMAP (8%)
Machine Requirements: GE 635

Source: Kennedy Space Center (KSC-10416)

Circle 13 on Reader Service Card.

RADAR WIND DIRECTION AND VELOCITY

This program computes a wind profile from radar data obtained by tracking a spherical balloon.

The balloon's position coordinates (azimuth, elevation, and range) are sampled at the rate of 10 per second, by the FPS-16 radar system, or at the rate of 20 per second, by the TPQ-18 radar system. These data are converted to rectangular position coordinates and are subsequently reduced to obtain wind measurements at constant increments of altitude, in units of feet or meters. These wind measurements are: wind velocities in horizontal rectangular components, resultant wind velocity, rate of change of balloon altitude with respect to time, wind direction, component wind shears, and resultant wind shears.

Either all wind measurements or all except shears are printed. Altitude, resultant wind velocity, and wind direction can be recorded on magnetic tape, paper tape, or cards.

The following SC-4020 plots can be made: both horizontal rectangular components of wind velocity versus altitude, resultant wind velocity versus altitude, and wind direction versus altitude.

Language: FORTRAN IV (50%), GMAP (50%)
Machine Requirements: GE 635; SC 4020

Source: Kennedy Space Center (KSC-10432)

Circle 14 on Reader Service Card.

INTERPLANETARY TRAJECTORIES, ENCKE METHOD (ITEM)

There was a need to compute, with maximum accuracy and efficiency, a variety of interplanetary trajectory problems.

The Encke method has been shown to require minimum time in trajectory computation, with minimum loss of accuracy. Using an improved variation of the Encke method, the ITEM program has been developed; it avoids accumulation of round-off errors and avoids numerical ambiguities arising from near-circular orbits of low inclination.

ITEM trajectory computation consists of two parts: (1) the exact solution to the Kepler two-body problem and (2) integrated additions to this solution which account for perturbation effects.

Since perturbations only are integrated, the allowable integration interval is fairly large over most of the path. Even in the vicinity of the Earth, or another planet, a relatively large interval (compared to other schemes) may be used without limiting stability, or accuracy of the solution.

Round-off errors are controlled by keeping perturbation displacement small. The two-body orbit is rectified whenever the perturbations exceed a specified maximum value, which is established by comparison with the corresponding unperturbed value. Further, the reference body is changed as necessary, with the Earth, another planet, or the Sun selected as the reference body, whenever that body would otherwise contribute the largest perturbing force.

Numerical ambiguities, such as would be introduced by circular orbits or zero inclination, are avoided, by defining the problem in terms of parameters which have real physical significance (position and velocity vectors) directly related to measurable quantities.

Flexibility is provided by means of numerous options available to the user through a detailed system of control cards, which can be selected in adapting the program to wide variations in problem type and complexity. In addition, a subroutine, MODIF, permits the user to modify program parameters which normally are constant.

Language: FORTRAN IV
Machine Requirements: IBM 360

Source: Fred H. Whitlock
Goddard Space Flight Center and
Henry Wolfe, Leon Lefton, and
Norman Levine of
Analytical Mechanics Associates, Inc.
under contract to
Goddard Space Flight Center
(GSC-11576)

Circle 15 on Reader Service Card.

GEODETIC TO AZIMUTH, ELEVATION, AND SLANT RANGE

This program computes the look angles of an observed point for single or multiple observation sites. The computations involve a transformation from the geodetic coordinates to azimuth, elevation, and slant range.

The input to the program is the latitude, longitude, and height for the observed point and the observation sites. The spheroid dimensions that are used in the transformation are also part of the input. The output is a listing of the azimuth, elevation, and slant range for each observation site.

Language: FORTRAN IV
Machine Requirements: GE 635

Source: Kennedy Space Center
(KSC-10421)

Circle 16 on Reader Service Card.

XYZ TO AER LOOK ANGLES CONVERSION AND PLOTTING PROGRAM

This program computes azimuth and elevation look angles (A and E) in addition to range (R). Input to this program is either a Standard KSC Trajectory tape or data cards containing X, Y, Z position coordinates and time. These coordinates are referenced to a right-handed Cartesian coordinate system where the positive X axis is directed from true north by some input azimuth, the X-Z plane is tangent to some earth model or located at some known height above it, and the positive Y axis is directed up from the X-Z plane where Z completes the right-handed relationship. This then defines the present system used at KSC where the positive X axis is downrange, the positive Y axis is up, and the positive Z axis is the off-range component. Position coordinates are then converted to A, E, R output for a maximum of 25 output stations.

Input constants required by this program are: the semimajor (a) and semiminor (b) axes of an earth model, in meters; the azimuth of the X axis, in degrees, for the coordinate system described in the above paragraph; the latitude and longitude, in degrees, minutes and seconds; and the height, in meters, of the input origin and each output station. The X, Y, Z input data may be in either feet or meters.

The output parameters of this program are printed in tabular form and recorded on a magnetic tape. A companion program is included which uses the above tape to generate an SC-4020 input tape for plotting the output parameters. The SC-4020 output consists of from one to three frames (plots) per tracking station, with a blank frame separating stations.

Language: FORTRAN IV (85%), GMAP (15%)
Machine Requirements: GE 635; SC 4020

Source: Kennedy Space Center
(KSC-10426)

Circle 17 on Reader Service Card.

ELLIPTIC GROUND-RANGE PROGRAM

This program computes the ground range from the lift-off point to impact, assuming vacuum conditions, with a nonrotating spherical earth.

Inputs to the program are: a case number; an initial ground range; and the altitude, velocity, and path angle (angle with respect to the local horizontal) of a vehicle at this initial range.

The output of the program is: the case number; the initial ground range; and the altitude, velocity, path angle, and ground range at impact.

Language: FORTRAN IV
Machine Requirements: GE 635

Source: Kennedy Space Center
(KSC-10404)

Circle 18 on Reader Service Card.

WIND-TRAJECTORY TRACING FOR AIR-POLLUTION STUDIES (AIRPOL)

The Los Angeles Air-Pollution Control District needed a method for tracing air parcels either forward or backward in time.

The Wind-Trajectory Computer Program has been written to provide an output that traces wind patterns in the Los Angeles Basin. With modification and appropriate wind data, this program could be applicable to other areas.

There are actually two programs: (1) a data handling program and (2) an analysis program. The two must be executed in order.

The program is a non-real-time program. As input data, the program takes wind vectors, wind-station parameters, and the locations of the desired starting points. The program computes and lists the air parcel locations in half-hour steps, either for the duration of the time span requested or until no wind vector is available. In addition, it traces a nondispersing wind parcel either forward or backward in time and does so in two dimensions.

The value of such a program is that: (a) it can provide data on the areas affected by an air pollution source; and (b) if a monitoring station detects a pollutant, the upstream path of the air can be traced, and the potential pollution sources can be narrowed considerably.

Language: FORTRAN IV
Machine Requirements: IBM 360/44

Source: A. B. Street and J. N. Strand of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11892)

Circle 19 on Reader Service Card.

Section 3. Management Techniques

PRODUCT-PLAN PROCESSING SYSTEM

This program provides complete data processing of the product plan for an entire project. The program is capable of updating a master product plan, merging and sorting information into report sets, and generating final reports on a magnetic tape for listing at a later time.

The product-plan processing system consists of three major blocks: the update process, the merge-and-sort process, and the report-generation process.

Language: IFNAP
Machine Requirements: CDC 924A

Source: Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-16763)

Circle 20 on Reader Service Card.

COMPUTER PROGRAM FOR COST ESTIMATING

This computer program accepts basic raw data on the amount of testing to be done for a proposed project, an estimate of the cost per test, and the respective manpower loadings required to reduce each set of test data. The cost per test and manpower loadings are determined from previous experience with the type of testing and data reduction/analyses to be performed. From these raw data, the computer performs all simple arithmetic operations to arrive at the proper manpower for each cost cell for each project month.

The total manpower curve is often too coarse or gross, in terms of reasonable personnel assignment, when it is directly proportional to estimated project needs. Therefore, the computer program automatically proceeds to smooth the monthly manpower allotments while keeping the total cost unchanged. After each degree of smoothing, the results are printed out. The user may then select the results which represent the desired degree of smoothing.

Experience with the computer program shows significant savings in time over the manual method, which is directly translatable into money and utilization of manpower. Since it is a machine, the computer is only as accurate as the data and instructions fed into it. However, it will not duplicate most of the human errors common to manual calculations. Finally, the smoothing routine eliminates much of the "eyeball" guessing normally associated with this type of process.

Although this computer program was developed for the test phases of the LM descent engine, it could be used, for instance, with minor modifications, in estimating the cost of an item coming off a production line. The program is reasonably straightforward and allows for the insertion of cost and labor data virtually irrespective of the resulting product.

Language: FORTRAN II
Machine Requirements: SDS 955

Source: J. T. Latimore of
TRW, Inc.
under contract to
Johnson Space Center
(MSC-12308)

Circle 21 on Reader Service Card.

WEEKLY MANPOWER ANALYSIS

The manpower analysis program is a labor cost summary of tasks with applicable personnel per division and section, along with hours and overtime hours worked per week. It provides weekly reporting of labor hours worked by individual and by job, including both straight-time and overtime. At least 25 separate jobs, using people from at least 11 separate work areas, can be included in the program. Labor costs can be added with little additional programming effort, if desired.

Outputs include a listing of each job worked, the name of the individuals doing the work, their division, their straight-time hours, and their overtime hours. At the end of each job, total hours worked, equivalent manpower utilized, and an overtime analysis are printed. At the end of the run, a summary matrix of labor applied to all jobs worked, and work areas participating on the jobs, is printed.

The program has the advantages of utilizing a simple input combined with that of compactness, resulting in both individual job detail and an overall work summary. The program can save up to 100 hours of mechanical effort per run and reduce overhead costs 10% when the weekly run is first implemented on a 15-job by 11-work-area project.

Language: FORTRAN II
Machine Requirements: IBM 1620

Source: Jet Propulsion Laboratory
(NPO-11185)

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FORTRAN MANPOWER ACCOUNT PROGRAM

It was desired to determine the manpower-use cost for a group of mathematics analysts who work on a variety of tasks for a variety of different projects, people, and sections. The mathematics analysts are grouped into three categories: (1) full-time company employees, (2) part-time company employees, and (3) contractor personnel.

A computer program was developed to handle the problem.

This program provides the user with several different tables on which he can base his manpower-use cost. The information given by these tables:

1. provides summaries for weekly and monthly activity reports:
2. keeps track of the expenditure of contractor hours and dollars with estimates of depletion, so that procurement can be initiated in sufficient time to avoid interruption in contractor services;
3. prepares summaries of which charge numbers are being used and at what rate; and
4. provides data which can be presented to management for annual reviews or when there is some question about a particular phase of the employee's use.

Some of the tables are very detailed, and some are merely summaries suitable for reports. The program recognizes several different breakdowns of personnel types and task categories and prepares separate tables for each of them. There are twelve different tables given in the output.

1. Personnel tasks and hours;
2. Current tasks;
3. Detailed activity report;
4. Summary of hours by section and task category;
5. Summary of hours by task duration and task type;
6. Summary of hours by type of people;
7. Contractor hours expended;
8. Contractor dollars expended;
9. Tasks completed;
10. Summary of hours by project;
11. Summary of hours by charge number; and
12. Missing task cards.

The program listing and the documentation is offered as one complete package due to the way the documentation is written.

Language: FORTRAN IV
Machine Requirements: IBM 360/65

Source: J. N. Strand of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11973)

Circle 23 on Reader Service Card.

INVENTORY-INDEX ONLINE PRINT PROGRAM (SPECFILE)

SPECFILE is used to provide online listing of specification data-bank-system inventory tapes. The program will show preselected portions of each 326-character record, including full title and type, the method of online printing of portions of inventory information, and multiple title segments with a maximum of four lines. The online printout consists of the heading, the inventory listing in document-number sequence, the counter, and the program ID or signature line.

Language: FORTRAN H
Machine Requirements: IBM 360, Release 11

Source: Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-18759)

Circle 24 on Reader Service Card.